

Wilcox Oil Company Superfund Site

Work Plan for Investigation of Lead Contamination at the Ethyl Blending and Lead Sweetening Areas

Bristow, Creek County, Oklahoma

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Contents

1. Introduction	1-1
1.1. Objective.....	1-1
1.2. Existing Conditions.....	1-2
1.3. General Strategy.....	1-3
1.3.1. Sample Collection Methods.....	1-3
1.3.2. Overview of Incremental Composite Samples and X-Ray Fluorescence Analysis	1-3
1.3.3. Soil Particle Size Considerations	1-4
1.3.4. X-Ray Fluorescence Analysis.....	1-5
1.3.5. Wet and Indurated Samples	1-5
1.3.6. General Sample Design.....	1-5
2. Sampling Design and Strategy for the Lead Sweetening Area	2-1
2.1. Source Area Description	2-1
2.2. Sampling Design.....	2-2
2.2.1. Surface Soils (0 to 6 inches).....	2-3
2.2.2. Subsurface Soils (6 to 24 inches)	2-4
2.2.3. Confirming the Delineation with Decision Units	2-5
2.3. Decision Logic	2-6
3. Sampling Design and Strategy for the Ethyl Blending Area	3-1
3.1. Source Area Description	3-1
3.2. Sampling Design.....	3-2
3.2.1. Sampling outside the Buildings	3-3
3.2.2. Sampling the Dirt Floor inside the Buildings	3-4
3.2.3. North-South Area Kriged from In Situ X-Ray Fluorescence Readings by ERT	3-4
3.3. Decision Logic	3-5
4. References.....	4-1

Figures

Figure 1: Wilcox Oil Superfund Site Location	1-2
Figure 2: Sampling Devices.....	1-7
Figure 3: Sample Strategies and Designs.....	1-8
Figure 4: Lead Sweetening Area Lead Contour Map (from ERT, 2016).....	2-2
Figure 5: Example of Proposed Screening Transects at the Lead Sweetening Area	2-4
Figure 6: Example Decision Units for confirmation of area less than 200 mg/kg	2-5
Figure 7: Decision Logic Diagram for the Lead Sweetening Area.....	2-6
Figure 8: Ethyl Blending Area	3-1
Figure 9: Ethyl Blending Area Lead Contour Map (from ERT, 2016)	3-2
Figure 10: Decision Logic Diagram for the Ethyl Blending Area	3-5

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1. Introduction

1.1. Objective

The presence of lead contaminated soil is suspected at two areas at the Wilcox Oil Superfund Site. The objective of this investigation is to identify the horizontal extent of lead contamination in the upper 2 feet of soil near these two suspected sources, and identify areas where lead concentrations in soil are greater than a screening level of 200 milligrams per kilogram (mg/kg). The site is currently in the Remedial Investigation and Feasibility Study (RI/FS) phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process and the results of this investigation will be used to support characterization, risk assessment and remedial action decisions. The focus of the activities described in this Work Plan is the investigation of lead contamination in soil. Other concurrent RI/FS activities during this first mobilization are being conducted by EPA Region 6 that address other media and chemical constituents at other areas.

This Work Plan includes the Sampling and Analysis Plan and is organized in four sections.

- **Section 1** is an introduction to the site and the general methods that will be used during the investigation. It describes the basis and theory of incremental composite sampling, and a general description of the sample designs that will be used during the investigation.
- **Section 2** is the Sampling and Analysis Plan for the Lead Sweetening Area (LSA) and presents a description of the sampling strategy, sample design and decision logic for the investigation.
- **Section 3** is the Sampling and Analysis Plan for the Ethyl Blending Area (EBA) and provides a description of the sampling strategy, sample design and decision logic for the investigation.
- **Section 4** provides references cited in this Work Plan.

All work described in this plan will be conducted in accordance with the Quality Assurance Project Plan (QAPP) which follows the format of the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)¹. The QAPP for The Characterization of Lead in Soil at the Lead Sweetening Area and Ethyl Blending Area at the Wilcox Oil Superfund Site is a separate document and includes conceptual site models (CSM), sample strategy, and quality assurance (QA) and quality control (QC) procedures that will be used during execution of this work.

¹ The UFP-QAPP is a voluntary consensus policy developed by the Intergovernmental Data Quality Task Force (EPA, DOE, and DOD). The documentation includes a User Manual (2005) and Optimized Worksheets (2012) and other supporting materials and training. The materials can be accessed at: <https://www.epa.gov/fedfac/assuring-quality-federal-cleanups#ufp-qapp>

1.2. Existing Conditions

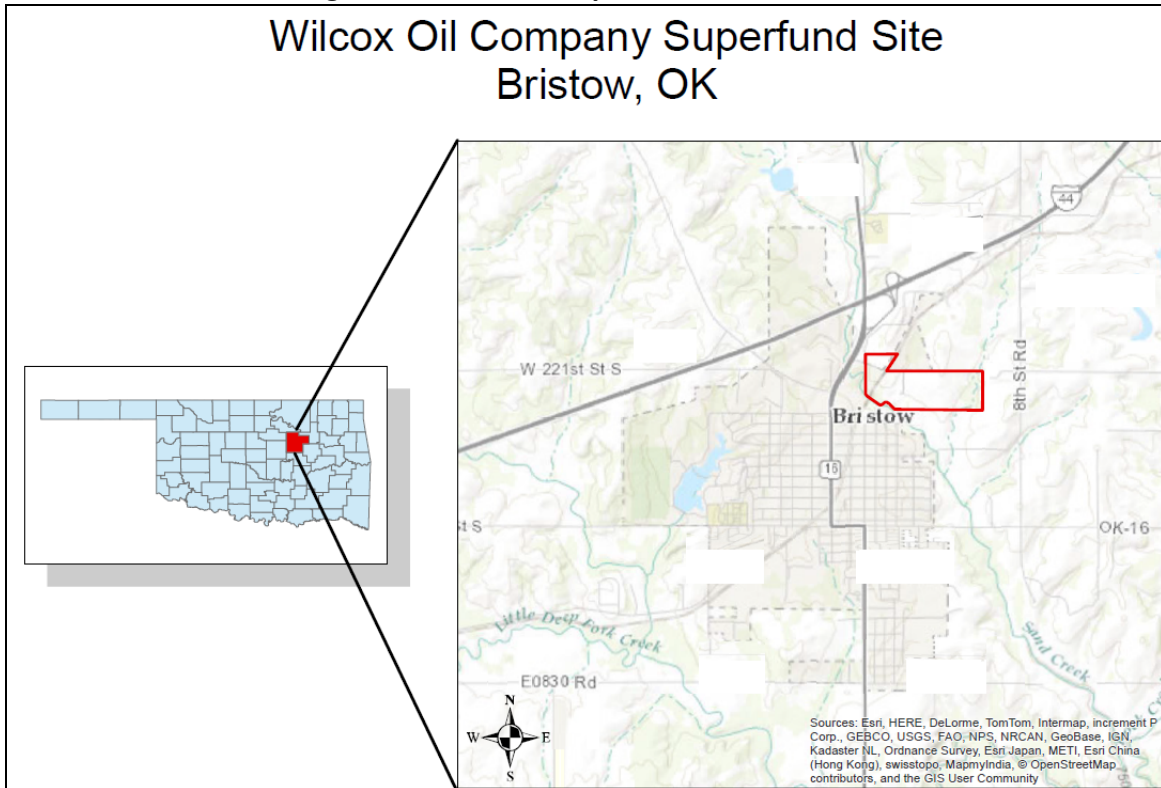
Wilcox Oil Company is an inactive and abandoned oil refinery located in Creek County, Oklahoma (Figure 1) in the northeast section of the town of Bristow, Oklahoma. The site encompasses 140 to 150 acres and includes five areas: the Wilcox Process Area, the Loraine Process Area, the Loading Dock Area, the North Tank Farm, and the East Tank Farm. Several preliminary investigations have occurred at the site beginning in 1994. In 2015, Lockheed Martin assisted the Environmental Protection Agency/Environmental Response Team (EPA/ERT) and EPA Region 6 to perform a direct sensing investigation to qualitatively address the nature and extent of contamination at several sites using direct sensing tools including the rapid optical screening tool (ROST™) and X-Ray fluorescence (XRF). Details of the site history and previous investigations can be found in the reports from these investigations (Lockheed Martin, 2016).

Within the Wilcox Process Area, the two areas containing lead as the contaminant of potential concern (COPC) in soil include:

- Lead Sweetening Area (LSA)
- Ethyl Blending Area (EBA)

The detailed sampling designs for each of these areas are presented in Sections 2 and 3 of this Work Plan, respectively, and provide a discussion of the suspected sources and existing conditions.

Figure 1: Wilcox Oil Superfund Site Location



1.3. General Strategy

The investigation of lead contaminated soil will be performed using the principles of Incremental Composite Sampling (ICS) and near real-time XRF analysis to delineate areas where surface and subsurface soils contain concentrations of lead in excess of 200 mg/kg. The approach will evaluate the following:

- Concentrations at suspected source areas and hotspots.
- Concentration trends away from known and suspected source areas (transects).
- Concentrations of Decision Units that represent areas above and below the 200 mg/kg screening level.

1.3.1. Sample Collection Methods

Soil from two depths will be evaluated. Surface soils, defined as samples from the ground surface to 6 inches (0 to 0.5 feet) will be collected to support ecological risk screening, and samples from 6 to 24 inches (0.5 to 2 feet) will be collected to support human health risk screening.

Samples will be collected using a soil sampling probe approximately 1 inch in diameter and 24 inches in length driven by hand (slam bar/slide hammer) or hand-held driver (pneumatic or electric hammer drill). Screening level surface samples will be collected using a modified CRREL Multi Increment Sampling Tool (CMIST), sometimes referred to as a Pogo Sampler. The modified CMIST can be used to rapidly obtain samples from surface soil and has been modified by EPA Region IV to facilitate sample collection from 0 to 6 inches. The sampling devices are shown in Figure 2 (page 1-6).

Soil samples will be collected in clean, sealable plastic bags and labeled with the site name and sample identification number. Samples will be processed and analyzed at the field lab. After analysis, samples will be archived and available for additional analysis, such as disposal classification via toxicity characteristic leaching procedure (TCLP), if needed.

1.3.2. Overview of Incremental Composite Samples and X-Ray Fluorescence Analysis

Contaminant distribution in soils is heterogeneous, and discrete sample methods cannot account for the variability in contaminant concentration over short scales. Additionally, discrete soils samples are representative of a single point and do not define the concentration of a specific area. The standard methods used to process soil samples and select the small volume (1 to 2 grams) for fixed-lab analysis results in additional uncertainty and bias in results. The sum of the sampling, processing and analytical uncertainties may result in a concentration that is not representative of the actual conditions and could lead to a decision error.

ICS is a soil sampling protocol that reduces data variability and reasonably assures all contamination present within a defined area or volume of soil is adequately represented in samples that are collected and analyzed. In ICS, many equal mass “increments” of soil collected from multiple locations within a

defined area or volume are combined into a single “field” sample that represents the area or volume of soil of interest. Combining increments may appear to be similar to conventional compositing of samples. However, ICS improves on the composite concept by establishing a Decision Unit (DU) that is represented by a single sample designed to contain all constituents in the same proportion as they are present in the DU (i.e., the sample is representative of a specific area – the DU). The DU represents the smallest volume of soil about which a project level decision is to be made (such as exposure risk or remedial action), and in some cases a DU comprises smaller units known as sampling units (SUs). By defining a DU, the ICS sample result represents the mean concentration within the area, which cannot be determined with discrete samples. The Interstate Technology and Regulatory Council (ITRC) has developed a guidance document that provides an extensive discussion on the theory and application of incremental sampling methodology (ITRC, 2013).

ICS requires specialized procedures both in the field and in the laboratory (preparation and analysis). The systematic planning process is an integral part of ICS that is required to develop a comprehensive sampling and analysis strategy. Planning includes defining the size and depth of the DU (volume represented by the sample), the number of increments of soil to be collected within the DU, the volume of each increment, and the processing required to ensure the sample is representative of the decision to be made.

XRF is a nondestructive analytical method used to measure the concentration of metals, including lead, in soil and other media. It is a complementary technology to ICS because it provides rapid analysis for real-time decision making. Rapid analysis allows adaptation of the sampling strategy to reflect the site specific conditions. The instrument can be deployed either hand-held for portable direct analysis of soils in the field, or stand-supported to analyze prepared samples in a more controlled environment, such as a field laboratory. In the field laboratory, measurement of lead in prepared samples takes between 2 to 10 minutes, depending on the number of repeat measurements required, and has a detection limit well below the decision criteria for this site.

1.3.3. Soil Particle Size Considerations

The criterion of “greater than 200 mg/kg lead” will be applied to the <10-mesh soil fraction initially. When analyzing samples for delineating the final 200 mg/kg boundary with SUs, or when delineating the final boundary with DUs, the samples will be further sieved to obtain the <100-mesh fraction for XRF analysis to ensure that the soil is compliant with the latest Superfund guidance for lead-in-soil exposure (OLEM Directive 9200.1-128, “Recommendations for Sieving Soil and Dust Samples at Lead Sites for Assessment of Incidental Ingestion,” July 2016). If soil conditions are such that disaggregation is difficult, and if it is found that DU “step-outs” are frequently required, the following procedure can be used to save time and labor:

- Sieve several DU samples to <10-mesh initially and analyze
- Re-sieve the samples to <100-mesh and analyze
- Compare the results for the <10-mesh and <100-mesh particle fractions

If the concentration difference between the two fractions is insignificant, or if the concentration of the <10-mesh fraction is greater than that of the <100-mesh fraction, the 10-mesh fraction can be used as an intermediate value until the final DU footprint is achieved.

1.3.4. X-Ray Fluorescence Analysis

Processed soils will be placed in a “read” bag and multiple XRF readings will be taken to determine a statistically valid estimate of the sample’s mean lead concentration. Raw XRF data are entered in a specially-designed spreadsheet that serves as 1) a permanent record of the XRF data for each sample, and 2) a real-time statistical calculator to determine the number of XRF readings required on the sample bag to reach statistical significance. When a decision is based on a single SU sample result, the “sample concentration” will be determined as the 95% t-UCL on the average of the multiple XRF readings on that sample bag.

1.3.5. Wet and Indurated Samples

The QAPP provides a detailed description of the soil sample processing and analysis methods. During sampling, the sample collection team will qualitatively evaluate the soils for moisture and cohesiveness (induration). Saturated soil or soils containing large amounts of rock fragments can interfere with XRF readings. Saturated or very wet soils may require drying prior to analysis, which is not anticipated to be performed at the site, and may result in a modification to sampling and analysis procedures. If soils are extremely hard or contain abundant rock fragments that limits the amount of sample collected, the procedures may be modified in the field. Modification may include collecting additional volume at increment locations, collecting additional increments, or abandoning the locations.

1.3.6. General Sample Design

For this work, two scales of incremental composite samples will be applied, one for determining the true concentration of a specified volume of soil (a DU), and another for determining a concentration trend across large areas of soil for the purpose of locating cleanup boundaries.

The ICS design that will be used to assess concentration trends and locate the 200-mg/kg lead cleanup boundary near surface and at depth will be based on SUs. An SU is a volume of soil that is typically much smaller than a DU for which the true concentration can be estimated with a lower degree of confidence than that used for DUs. DUs and SUs differ as to their purpose: DUs concentrations are typically compared to a cleanup, compliance or risk threshold, or are used as the exposure point concentration (EPC) as input to a quantitative risk assessment. The spatial pattern of contamination within a DU is of less importance than the DU’s true concentration. SUs are used specifically to gather and preserve information about spatial patterns of contamination, either within pre-defined DUs or before DUs have been defined.

SUs are sampled using fewer increments than typically used for DUs, because knowing the exact concentration is less important than identifying soil areas/volumes having “higher” vs. “lower” concentrations. SUs can be used within DUs for the purpose of targeting areas for cleanup if the DU concentration should exceed a cleanup threshold. SUs can also be used to reduce uncertainty in a CSM

by providing an understanding of the size of source areas and any concentration trends surrounding them. A more complete CSM allows the project team to design DUs of appropriate size and locate DUs such that there is little chance that a single DU will overlap areas having markedly different concentrations.

SUs cover small areas on the order of a few square feet. The number of increments must be no less than five, but the exact number depends on the heterogeneity of the soil. SUs are used rather than discrete samples because the high variability (i.e., “noise”) observed with discrete samples can either mask a true spatial trend, or falsely indicate a trend where none actually exists. The purpose of SU composite sampling is to suppress the misleading effects of short-scale soil heterogeneity (i.e., reduce the “noise”) so that a true trend signal can be observed. QA practices are used early in the project to establish the SU configuration (area of soil covered and the number of increments) that balances sufficient noise suppression against the level of effort involved with SU sample collection, processing and analysis.

Both SUs and DUs will be used to investigate the lead-contaminated areas of the Wilcox Oil Company Superfund Site. SUs will be used extensively to map the size and extent of the “sweetening area” identified by ERT. The exact configuration will be determined by the initial use of “SU couplets,” which are described in greater detail in the QAPP. The starting SU configuration will be nine increments arranged in three rows of three (3x3) over a 2-foot by 2-foot area (4 square feet) (Figures 3a and b). If the co-located couplets do not agree with each other, the SU configuration will be changed to enlarge the area covered and increase the number of increments until couplets agree. Once the appropriate SU configuration is established, single SUs will be used, although occasional couplets may be used as QC or to verify critical decision points, as indicated by conditions encountered in the field.

Lead data will be generated from the field samples using XRF. Within-sample heterogeneity will be controlled through a combination of sample processing and replicate XRF readings so the true sample concentration will be determined. Sample processing prior to XRF analysis will take exposure and transport mechanisms into account by evaluating the relationship between soil particle size and lead concentration. Rapid turnaround of sample concentrations will enable the project team to make real-time decisions that refine the SU configuration, and that locate the near-surface and at-depth 200-mg/kg boundaries in the most efficient means possible.

The SU strategy will be used to sample transects spoking from the known source area. SU data will be evaluated using geostatistical modeling (EVS©) and professional judgment to identify a tentative 200-mg/kg boundary. A DU strategy (larger, band-shaped areas sampled with 30 increments) will be used to confirm the 200-mg/kg boundary to complete the field investigation.

SU sampling will involve two types of soil sampling tools. Initial field work, especially when refining the SU configuration, will rely mostly on a modified CMIST sampler (Figure 2d) with a 6-inch depth cup. A 2-foot long/1-inch diameter probe will be used to collect subsurface soil samples (Figures 2a, b and c). The exact mechanisms used to deploy the probe will depend on the relative difficulty encountered when probing the subsurface.

Figure 2: Sampling Devices

Soil Probe and Drive Mechanisms: a.) Hand driven slam bar/slide hammer, b.) electric hammer drill, c.) small GeoProbe rig, d.) CMIST Sampler

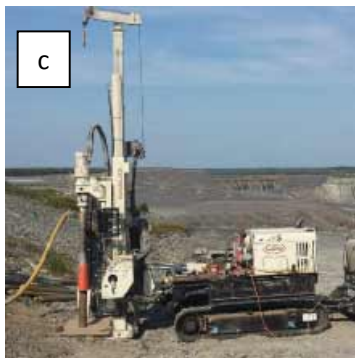
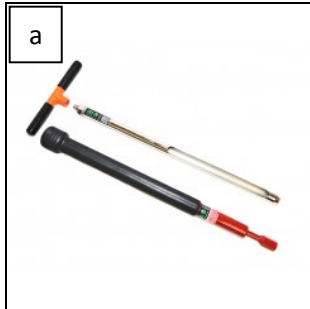


Figure 3: Sample Strategies and Designs

Figure 3a: Screening samples at potential source area collected using a nine-point increment.

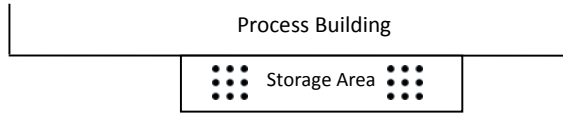


Figure 3b: Transect using series of nine-point incremental samples away from the source.

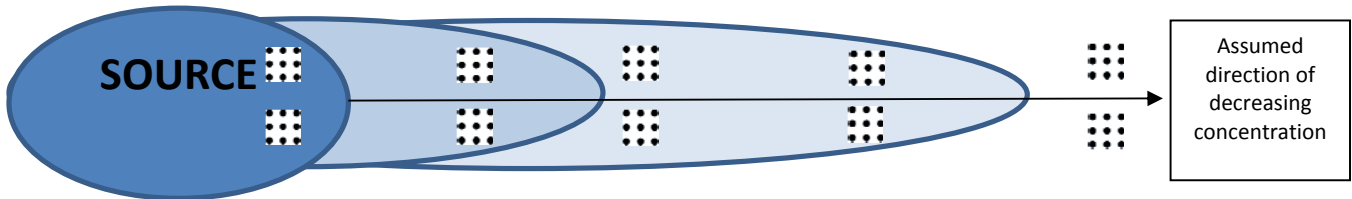
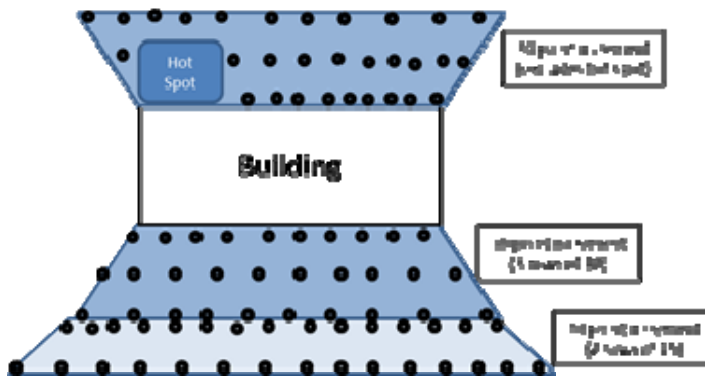


Figure 3c: Decision Units using a 30-point incremental sample.



If an elevated concentration of lead is found in a potential source area (PSA), the extent of lead above the screening level will then be delineated. Assuming that the lead concentration decreases with distance from the source, a series of nine-point samples will be collected along a linear path (a transect) (Figure 3b). This screening strategy will be used to identify the 200 mg/kg boundary on the transect. A series of transects radiating from the source area may need to be performed to develop the boundaries at multiple transect locations and define the area above the screening level.

After identifying the boundary of the contaminated area with screening sample transects, incremental composite samples will be collected over a larger area to confirm the concentration is less than the screening level. These DUs are generally less than 6,000 square feet. Only 30-increment samples collected across a DU will be used to delineate the screening level boundary. DUs may represent either ecological exposure units (0 to 6 inches), or human health exposure units (6 to 24 inches) (Figure 3c). It is possible that the DU for the 0 to 6-inch interval will be different from the 6 to 24-inch interval. The

size of a DU will be selected to reflect the resolution required for the decision and the physical characteristics of the area.

The description above represents a generalized approach for the sampling program. This Work Plan follows a Systematic Project Planning approach and uses a dynamic work strategy that allows for field-based decision making based on results from the near real-time XRF analysis. Site conditions and real time results may require modification or expansion of the strategies to optimize the sampling program and provide additional data for post-investigation decision making. Additionally, the two areas have different physical features and reflect different source and migration mechanisms and may require different strategies in the field. The specific approaches for sampling at each area are described in Sections 2 and 3 of this Work Plan.

2. Sampling Design and Strategy for the Lead Sweetening Area

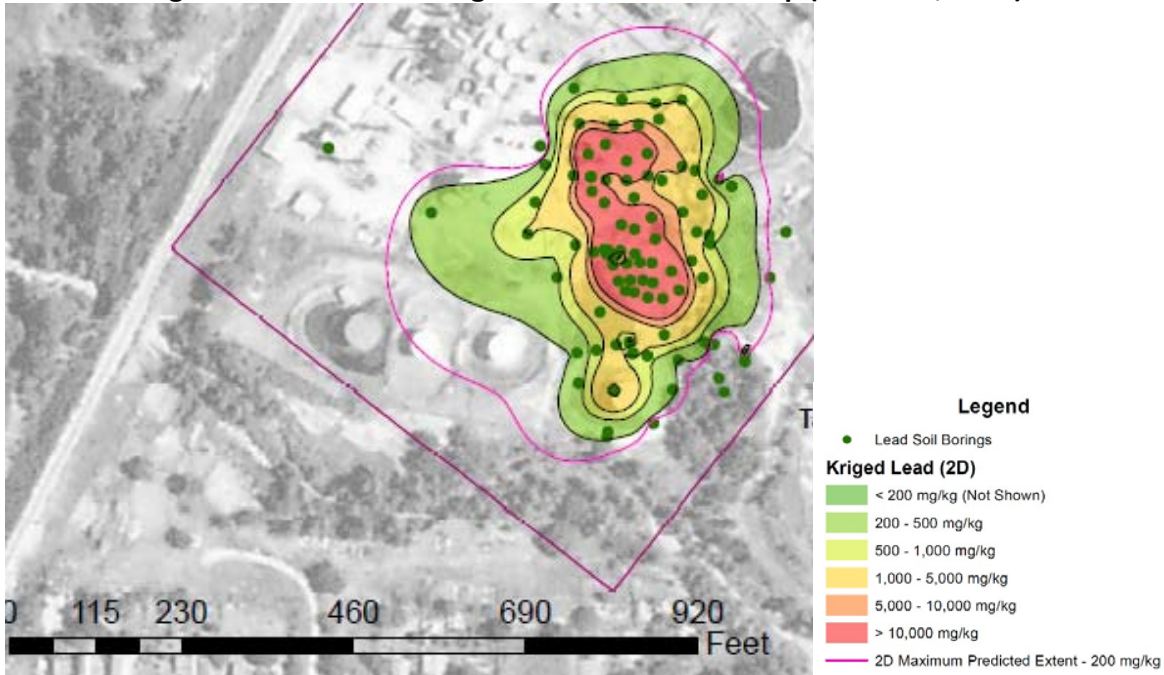
2.1. Source Area Description

The LSA is located in the south-central portion of the Wilcox property just north of Tank 34. Historical maps indicate the area contained acid tanks, agitators, treaters, nearby “run down” tanks, and condensate tanks. The LSA is currently very sandy with minimal plant growth and contains areas of sparkling sands/salts. Erosion is noted from this area to the south toward Sand Creek, and the tributary to Sand Creek to the east. Areas of dense trees, shrubs, poison ivy, and tall grasses surround the open sandy area. A metal fence extends through the eastern side of the investigation area, and there is a nearby elongated pond. Much of the infrastructure has been removed in the intervening years, and unmanaged vegetation has grown up throughout the area.

The ERT report (Lockheed Martin, 2016) states that the doctor sweetening process was used in this area and included sodium plumbite (Na_2PbO_2), sodium hydroxide (NaOH), and elemental sulfur or sulfonic acid to produce lead sulfide precipitate. The ERT investigation identified phenolic compounds in the subsurface soils that were associated with the process. Crystals were observed on the surface in this area and XRF analysis showed that they contained very high lead content (percent levels, above the calibration range). Vertical contamination of lead was investigated at five boring locations. In four of the locations, lead was found above 200 mg/kg in the upper foot of soil only, and at the remaining location it was detected at a maximum depth of 4 feet. Groundwater samples from the area show elevated lead concentrations (up to 151,000 milligrams per liter [mg/L] near Tank 34), and are believed to reflect perched water zones.

Modeling of the 2015 XRF data produced a contour map of lead concentration (Figure 4). The estimated area of concentration greater than 200 mg/kg is approximately 6 acres (600 feet north-south and 500 feet east-west) and the high concentration area, greater than 10,000 mg/kg, is approximately 0.6 acres (approximately 250 feet north-south and 100 feet east-west). Most of the soil sample lead measurements were taken with a handheld XRF at the ground surface, and there is limited data regarding the vertical extent of lead contamination. The subsurface sample near the center of the area analyzed showed high concentrations (greater than 5,000 mg/kg) at a depth of 1 foot.

Figure 4: Lead Sweetening Area Lead Contour Map (from ERT, 2016)



The soil concentrations of lead in the LSA are very high and worker safety will be the highest priority when sampling and handling these samples. Details of the health and safety requirements are provided in the Site Health and Safety Plan.

2.2. Sampling Design

The sampling design presented below is based on the CSM developed from preliminary information and handheld XRF data contained in the ERT report. The approach assumes, based on kriged and contoured data, the LSA contains a high concentration lead source in the middle, and concentrations decrease away from the source. An estimate of the 200 mg/kg delineation line based on the ERT XRF data is very rough but can serve as a starting point for additional delineation under this current investigation. This investigation will evaluate the concentration of lead in the two potential exposure zones in upper two feet of soil (0 to 6 inches and 6 to 24 inches).

The general approach will be to determine (1) the lateral extent and (2) if the lead is likely to have migrated vertically to the deeper soil (6 to 24-inch zone). The horizontal 200 mg/kg boundary will be located using SU composite samples along radial transects. Once the boundary is located, DUs will be established to confirm the concentrations on the less than 200 mg/kg side of the boundary. QC procedures will be implemented to evaluate SU precision during the investigation and refine the SU configuration (the area covered by the SU and the number of increments per SU), as necessary. The details of the approach are presented below.

The starting point for the delineation will be near the center of the high concentration area to determine the extent of horizontal and vertical (up to 2 feet) lead migration. Understanding the migration pattern will assist in developing the subsequent sampling locations and determine the

approach for collecting subsurface samples at each location. SU samples will be collected from soil cores at 0 to 24 inches in two areas adjacent to the highest concentration areas (yellow boxes on Figure 5). SU samples will initially consist of nine- increment composite samples collected in a 2 foot by 2 foot area. The selected sample locations provide depth information from the putative high concentration area, which appears to be elongated in a north to south direction (shown in Figure 4). The most northerly sample will be collected near the ERT location of WIL-AA-10, where previous samples showed concentrations of 929 mg/kg at 2 feet and 609 mg/kg at 4 feet. Cores will be split into 0 to 6 inch and 6 to 24 inch intervals, and the depth-specific core segments composited together so that each interval is analyzed separately. If lead concentrations greater than 200 mg/kg are found in the 6 to 24 inch intervals samples, the sampling strategy will continue with investigations to address the 6 to 24 inch interval as described in Section 2.2.2.

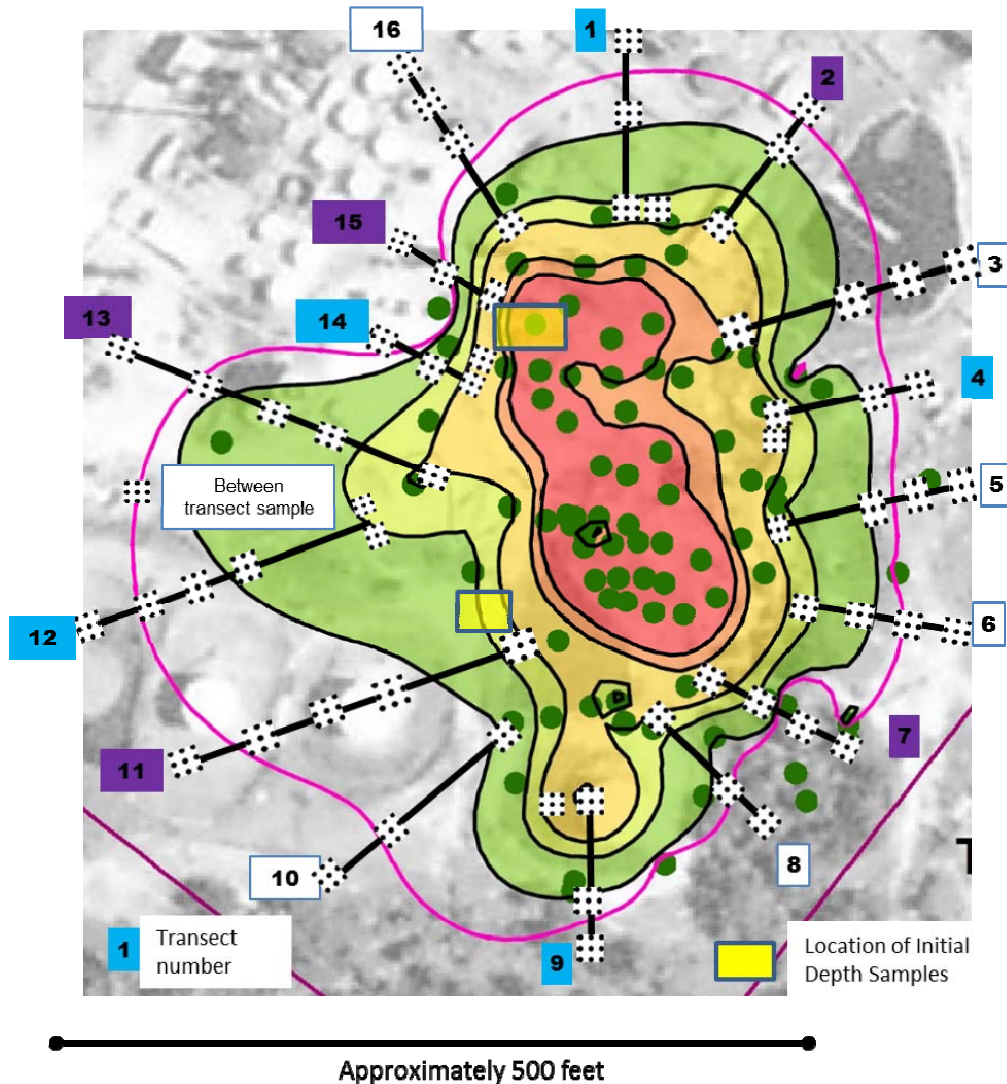
2.2.1. Surface Soils (0 to 6 inches)

Delineation of the 200 mg/kg boundary line will use surface SU samples along approximately 16 radial transects that cross the interpreted 200 mg/kg line developed from ERT XRF data (Figure 5). SU sampling along the transects will begin at the interpreted 200 mg/kg line and will extend either inward (if lead results less than 200 mg/kg) or outward (if lead results greater than 200 mg/kg). The proposed locations may be altered to address site conditions and avoid obstacles. The initial evaluation will be conducted using the modified CMIST sampler, which obtains soil from the 0 to 6-inch interval.

Initially, a transect of four pairs of side-by-side SU samples (SU couplets), one to two feet apart, will be used as quality assurance to test the reliability of an SU sample result. If poor precision is observed in this initial four-couplet data set, the SU configuration will be changed. Unless contra-indicated by conditions on the ground, the second SU configuration to be tested will cover a 3-foot by 3-foot area with 12 increments. The precision of the new configuration will be tested along the same test transect, with three to four sets of couplets, but offset slightly from the previous SU sampling location. If the couplet precision in this second three to four-couplet set is also poor, the number of increments will be increased. If a satisfactory SU configuration cannot be found, potentially all SU samples will need to be collected as couplets to control decision error. When a satisfactory SU configuration is found, subsequent SUs will be collected as singlets using that configuration.

After a satisfactory SU configuration is found and sufficient SU couplets have been collected, SU singlet sampling of LSA transects can begin (Note additional SU couplets will be required for QC). Sampling on a transect begins at the approximate 200 mg/kg boundary shown in Figure 5 or near the suspected 200 mg/kg line indicated by ongoing data collection. If the lead concentration of an SU is greater than 200 mg/kg, the next SU will be placed outward from the center. If the lead concentration of an SU is less than 200 mg/kg, the next SU will be placed inward towards the center. The goal is to have an SU above 200 mg/kg and at least one SU below 200 mg/kg along each transect. When the putative 200 mg/kg boundary has been bracketed, a second SU will be placed next to the decisive SU (to make a couplet) to confirm that conclusion. This step of confirming a decision indicated by coupling one SU with a second SU should be performed for more than 75% of the SU transects.

Figure 5: Example of Proposed Screening Transects at the Lead Sweetening Area



When a group of SU transect data has been completed, data are provided to the geostatistical operator for concentration contour modeling. Additional SUs/SU couplets or whole transects may be placed between existing transects to increase spatial coverage where professional judgment finds excessive uncertainty in the geostatistical modeling.

2.2.2. Subsurface Soils (6 to 24 inches)

During the Test-SU phase, subsurface soil samples will be collected as couplets along with the surface samples. If the Test-SU transect found that subsurface contamination (that is, lead greater than 200 mg/kg in the 6 to 24-inch depth interval) was not present (except perhaps at the very highest concentrations in the LSA center), SU sampling at the outer 200 mg/kg boundary does not need to include the 6 to 24-inch interval. However, SU samples will include the deeper interval in locations where there is uncertainty about the presence of subsurface lead. If any subsurface lead levels greater

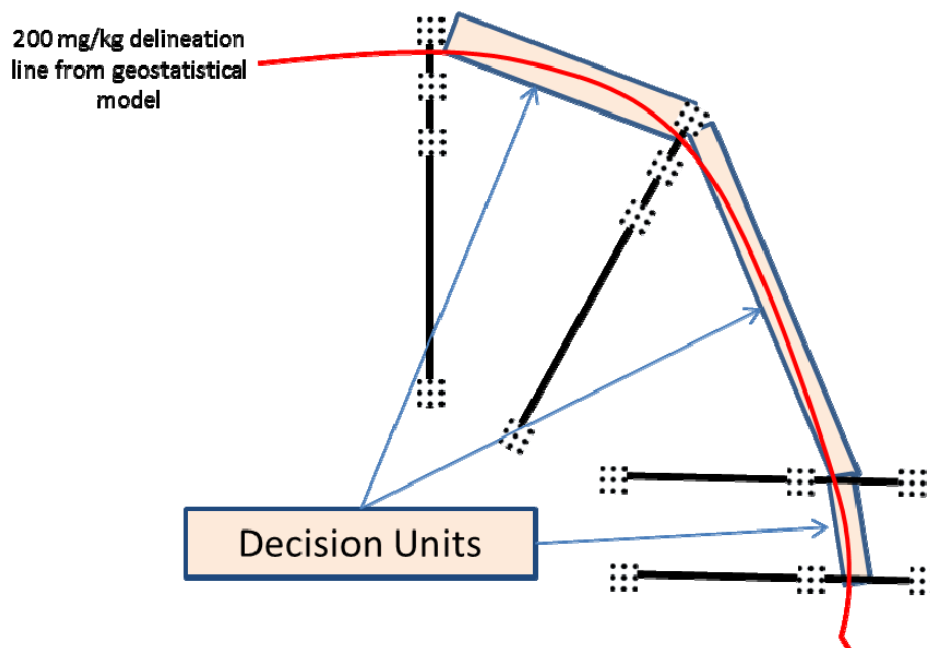
than 200 mg/kg are found, the areal extent of the contaminated 6 to 24-inch interval must be delineated using SUs and geostatistical modeling.

SU samples (both 0 to 6-inch and 6 to 24-inch) will be collected from the two locations flagged as the highest in situ concentrations found in the LSA during the ERT investigation (shown as yellow boxes on Figure 5). Both the surface and subsurface samples at each of the two locations will be examined visually for lead crystallization, and both will be analyzed to evaluate the relationship between surface and subsurface lead concentrations. If the subsurface lead concentrations are less than 200 mg/kg at both high concentration locations, and other subsurface analyses performed to that point also show subsurface concentrations less than 200 mg/kg processing and analysis of other subsurface samples may be put on hold, depending on the consistency of subsurface sample results.

2.2.3. Confirming the Delineation with Decision Units

When modeling of the SU data is judged to have produced a sufficiently confident estimate of the 200 mg/kg contour line, band-shaped 30-increment DUs (about 10 feet wide) will be used to confirm the border sections of the cleanup area. A border confirmation DU may be placed over the 200 mg/kg contour line bridging transects (as in Figure 6), or may be positioned with the DU's inner edge on the contour line. Since a maximum of 16 transects is anticipated, a maximum of 15 border DUs is anticipated. The field QC goal for DU data is to have triplicate replication in at least 20% (1/5th) of the boundary confirmation DUs. Therefore, a minimum of 3 border DUs need triplicate incremental samples (ISs), although it is likely there will be more.

Figure 6: Example Decision Units for confirmation of area less than 200 mg/kg



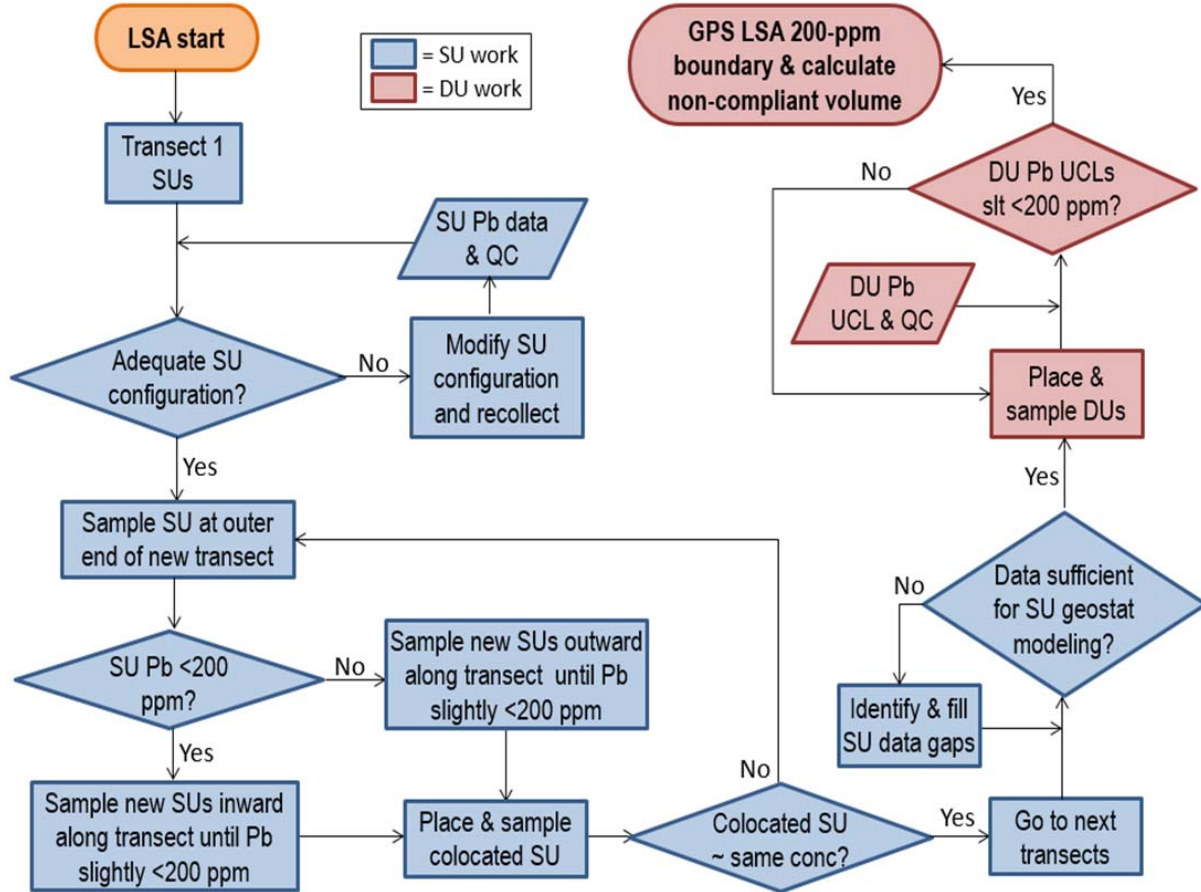
Lead concentrations in the subsurface soil this far from the LSA center are anticipated to be consistently well below 200 mg/kg (as demonstrated the SU data). If this holds true, boundary confirmation DUs will sample only the 0 to 6-inch surface soil interval. If this does not hold true, border DUs may require sampling of both the surface (0 to 6-inch) and subsurface (6 to 24-inch) intervals.

All final DU decisions are based on the lead content in the <100-mesh particle fraction. Samples must be sufficiently disaggregated to produce a sufficiently representative <100-mesh sample. If the DU concentration (or the 95UCL) is greater than 200 mg/kg, the Project Technical Lead may choose to resample the DU with more increments, or shift the DU outward and resample, as described in the QAPP.

2.3. Decision Logic

The decision logic for the LSA is presented in Figure 7.

Figure 7: Decision Logic Diagram for the Lead Sweetening Area

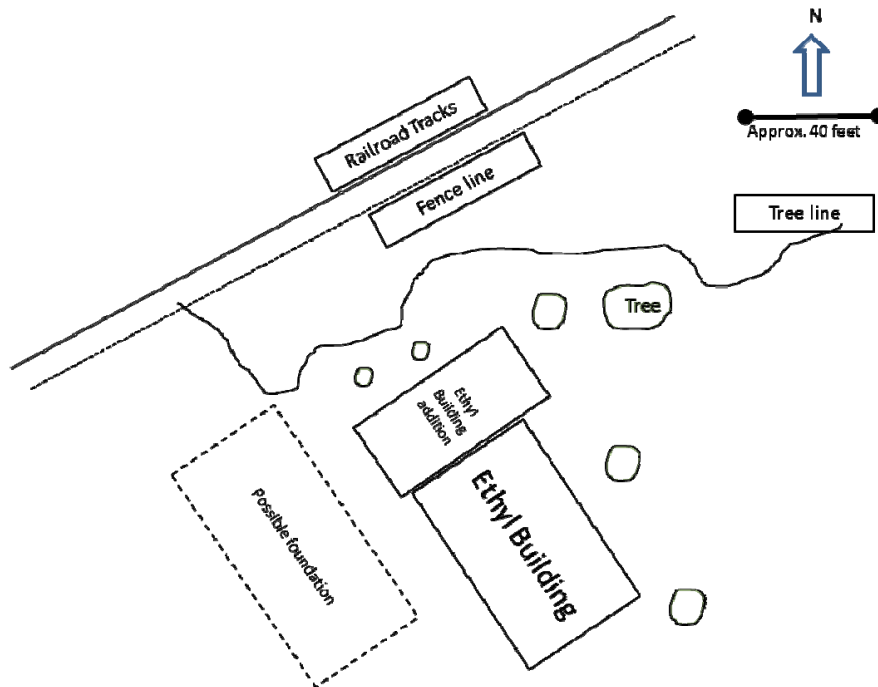


3. Sampling Design and Strategy for the Ethyl Blending Area

3.1. Source Area Description

The EBA is located in the Upper Wilcox Process Area in the northwest corner of the Wilcox property (Figure 1). The area contains an intact main building measuring approximately 45 by 40 feet, with a sign reading “Ethyl Blending” and was presumably used to blend liquid tetraethyl lead (TEL) into the final gasoline product. TEL, which was TEL blended with the lead scavengers 1,2-dibromoethane and 1,2-dichloroethane, is normally supplied as ethyl fluid and contained a reddish dye to distinguish treated from untreated gasoline. Historical maps and photographs show no other permanent buildings within approximately 100 feet, but a rectangular feature (possible fence, slab or foundation) appears to be present on the southwest side of the building. Recent aerial photographs indicate the area is relatively flat and currently contains several large trees. A line drawing of the EBA, developed from a recent aerial photo is shown in Figure 8.

Figure 8: Ethyl Blending Area

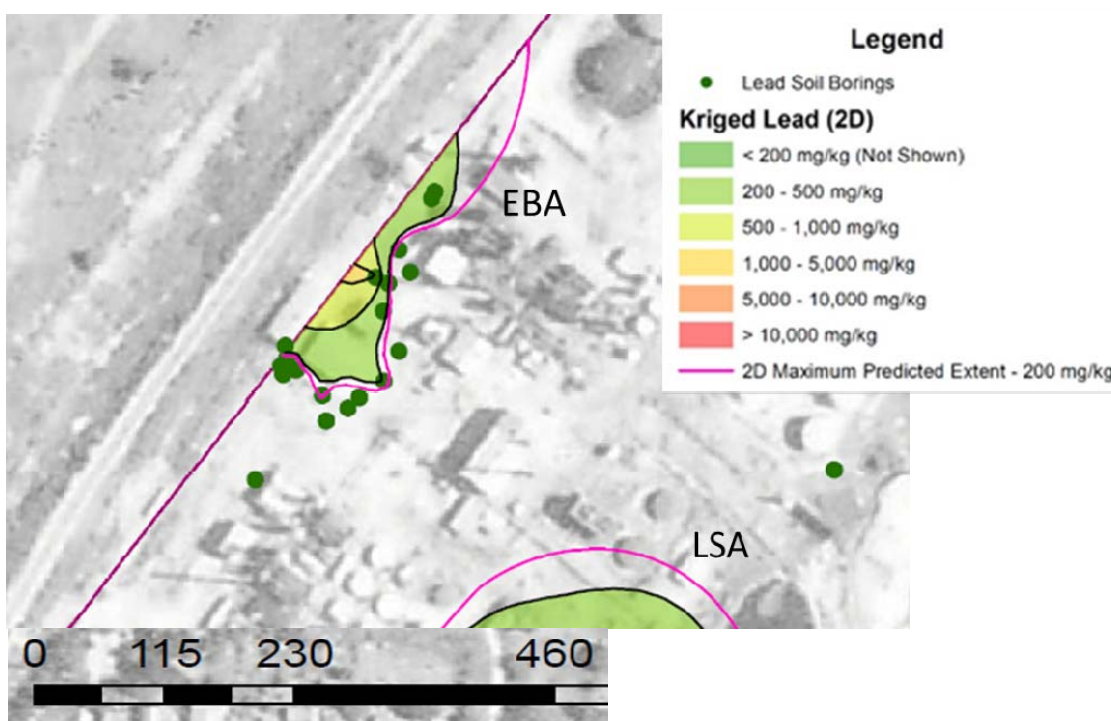


Historical aerial photographs show that between 1941 and 1956 the building was expanded to the northwest and the addition appears to have a lower roofline possibly indicating a storage area approximately 20 by 50 feet. Lighter colored ground on the southeast side of the building indicates surface disturbance. Access to the building includes a road parallel to the railroad and fence line that terminates at the northwest side (rear) of the building, and a larger road to the east that services several buildings in the area. A site visit by EPA staff in August 2016 found the area densely grown up with brush and poison ivy. Two structures are present. The main building is solidly enclosed with a concrete floor;

one side of the building is very close to the railroad tracks. The adjacent structure is little more than a shed with open sides and with a dirt floor under which trucks may have stopped to load/unload. Rusted drums and fragments of equipment are present in and around the buildings. Small bore steel piping is still visible along sides of the buildings. There is at least one concrete basin that holds rain water.

The ERT investigation included screening surface soils with XRF at approximately 25 locations in the EBA. There is limited discussion of the EBA results in the ERT report, but a contour map of lead concentration was prepared and is shown in Figure 9. The map shows an area of lead contamination above the 200 mg/kg screening level near the building, increasing in concentration westward towards the railroad and Lorraine area. The area greater than 200 mg/kg extends less than 100 feet to the east, but appears to be elongated several hundred feet in the north-south direction. Most readings were between 100 and 600 mg/kg. The maximum concentration was 1,449 mg/kg.

Figure 9: Ethyl Blending Area Lead Contour Map (from ERT, 2016)



3.2. Sampling Design

The sampling design reflects an early CSM based on the limited knowledge and data regarding the history, source and existing conditions at this area. This approach assumes that the building and its immediate proximity is the most likely source area, and concentrations decrease away from the source. However, the ERT contour map suggests a contamination pattern that increases away from the rear of the building (to the northwest).

The sampling strategy for determining if lead concentrations greater than 200 mg/kg are present (and if so, then delineating a 200 mg/kg boundary) will begin with a visual evaluation of existing conditions for indications of potential release mechanisms. PSAs could include material storage areas, product transfer

points (such as piping or valves), release areas adjacent to doors, and any stained or distressed areas near the building. Each side of the building will be considered and evaluated individually. The hand-held XRF may be used in situ mode to test the soil surface for contamination in these areas as a means to test and evolve elements of the EBA's CSM, assess the potential EBA sampling workload, and refine the EBA sampling strategy.

Exploratory investigations will be conducted in the 0 to 6-inch depth interval, but the 0 to 6-inch findings will be confirmed at the two depth intervals (0 to 6 inches and 6 to 24 inches). Depth samples will be collected using a 2-foot corer/probe. All 2-foot cores from the same SU or DU will be split into 0 to 6-inch and 6 to 24-inch intervals, and like intervals will be combined to form an incremental sample representing that depth.

An area of soil with lead concentrations greater than 200 mg/kg will be considered significant if

- the volume of soil exceeding the 200-mg/kg lead threshold is larger than 4 square feet in either the 0 to 6-inch or 6 to 24-inch depth interval, and it has a lead concentration greater than 400 mg/kg, or
- there is more than 1 SU along the side of a structure that has a concentration greater than 200 mg/kg, or
- the RPM determines it significant using professional judgment.

In general, if SU samples find that large areas of contamination greater than 200 mg/kg exists in both depth intervals, 30-increment DUs (at both depth intervals) will be placed just outside the SU-identified area to confirm the 200 mg/kg cleanup boundary. If contamination only occurs in the surface interval, 30-point DU samples will only encompass that interval. If all SU samples show lead levels less than 200 mg/kg, the entire side of the building will be bordered by a 10-foot wide, 30-increment DU (3 rows of 10) sampled at both depth intervals and with triplicate DU-ISs. No matter what the outcome, the project manager will be supplied with exposure point concentrations for the 0 to 6-inch interval and the 0 to 24-inch interval. If applicable, a cleanup footprint and estimated cleanup volume will be supplied.

3.2.1. Sampling outside the Buildings

Sampling will begin in any PSAs identified around the building and the location of the highest lead concentration from the ERT investigation (Figure 9). PSA locations will be evaluated for elevated lead concentrations using SUs. The SU will be composed of 9 to 16 increments using the default 3x3 point over 2-foot by 2-foot area configuration or the SU configuration optimized in the LSA work. SUs will be collected at both the 0 to 6-inch and 6 to 24-inch depth intervals.

The 1-sided 95% t-UCL from the RTeX form will be used to identify any SU sample having a conservatively estimated mean lead concentration greater than 200 mg/kg. Such an SU is considered to be a "hot spot." To evaluate the potential for hot spots, collect additional SU samples (at both depths) near the original location where the lead concentration exceeded 200 mg/kg and along the same side of the building, using the following approach:

- Place the additional SU samples such that their borders touch the borders of the first SU, and there is continual spatial coverage.

- If all bordering SUs are less than 200 mg/kg, and if the SU configuration being used is larger than 4 square feet, cover the original SU (the high concentration area) with up to four 4-square foot SUs to determine the actual size and location of the hot spot.
- After refinement of contamination extent at depth, 30-increment DUs will be placed to confirm 200 mg/kg cleanup boundaries for PSAs at both depth intervals.
- If all 0 to 6-inch interval SU samples are less than 200 mg/kg, the entire side of the building will be bordered by a 10-foot wide, 30-increment DU sampled at the 2 depth intervals.

3.2.2. Sampling the Dirt Floor inside the Buildings

During field reconnaissance, the field team observed that the eastern building appeared to have a dirt floor. The approach to sampling inside the building will include:

- A visual evaluation of the floor to identify hot spots, and subsequent sampling of them using SUs.
- Development of one or more DUs inside the building, and sampling of each DU using a 30-increment sample. Samples will be collected and analyzed from both the 0 to 6-inch and 6 to 24-inch interval.

The inside of the west building will be inspected for soil or similar loose material that can be gathered into an XRF read bag. Samples will be collected and analyzed to determine whether inside construction materials might be contaminated with lead.

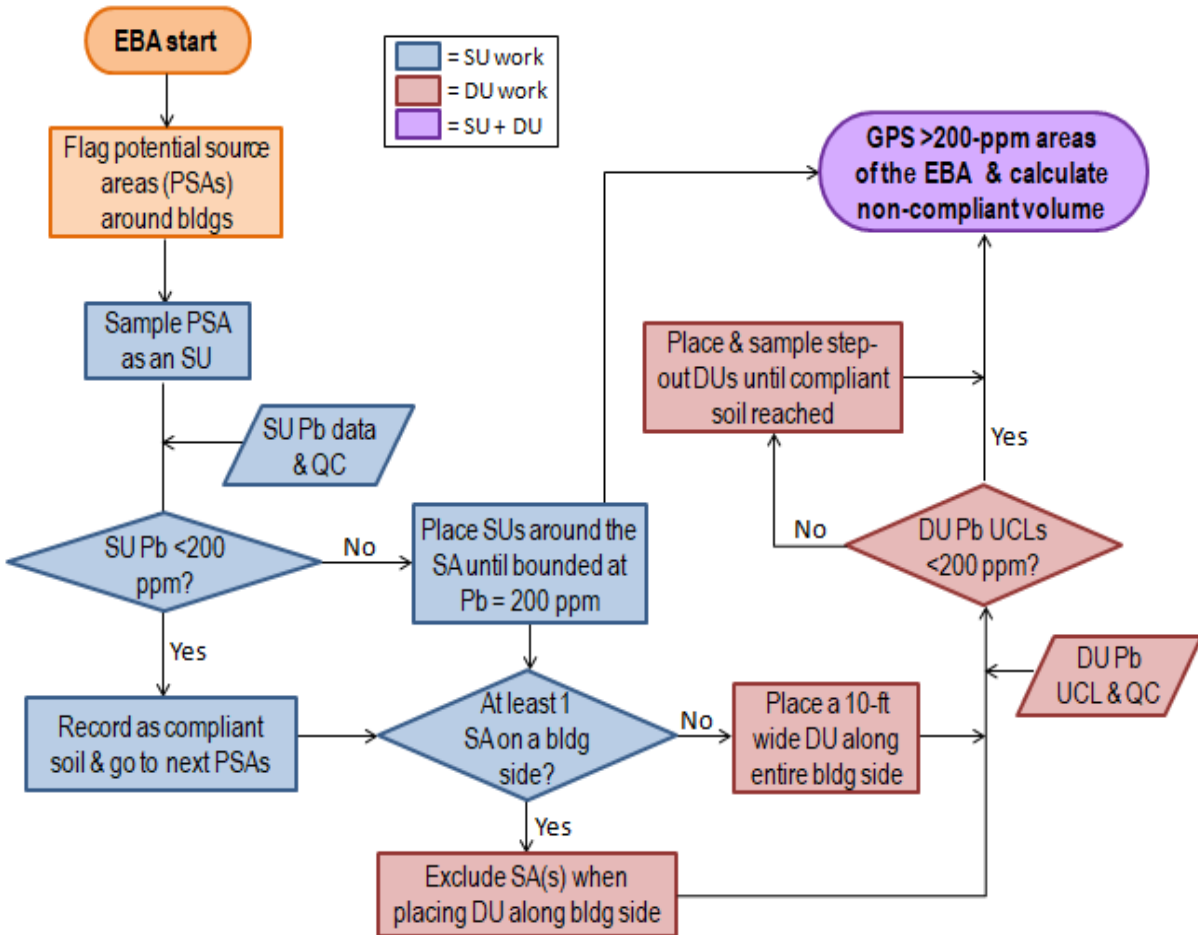
3.2.3. North-South Area Kriged from In Situ X-Ray Fluorescence Readings by ERT

The kriged area shown in Figure 9 will be investigated with a string of exploratory (0 to 6-inch depth) SUs to determine whether the elevated in situ XRF readings recorded by ERT represent areas of significant concentration. If areas of significant concentration are found, SU samples at both depth intervals of interest will be collected. If necessary, a contaminated area will be bounded by DUs to establish a 200-mg/kg perimeter.

3.3. Decision Logic

The decision logic for the EBA is presented in Figure 10.

Figure 10: Decision Logic Diagram for the Ethyl Blending Area



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